Defense Information Systems Agency

A Combat Support Agency

Tactical Edge Service:
Service Adaption

GIG EWSE Application and Service (EE212)

17 August 2011

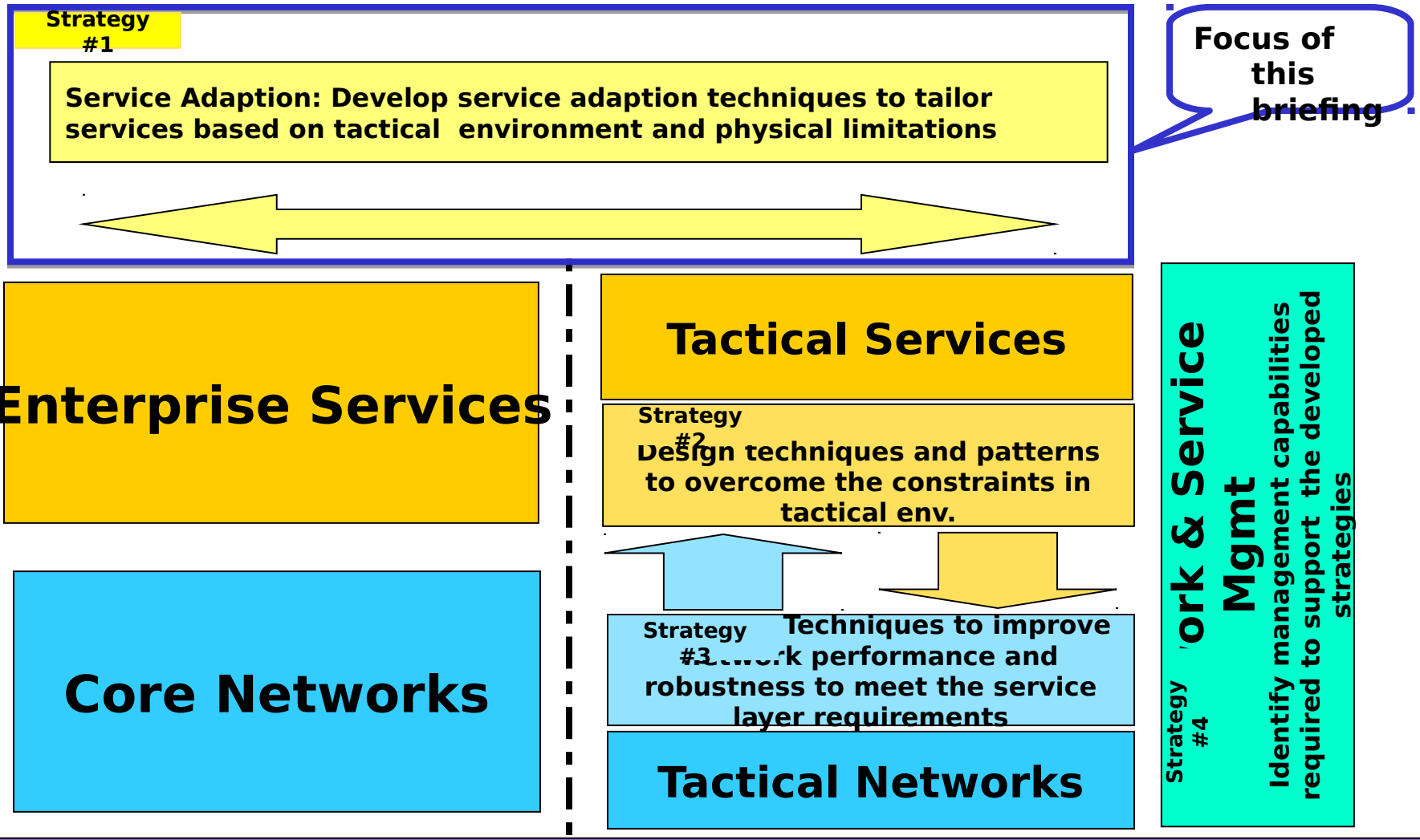
DISA
A Combat Support Agency

Outline

- Describe Service Adaption Strategies
- Show Technical Solution Using Example Problems
- Summarize Relevant EWSE Activities and Findings

Technical Approach Framework

A Combat Support Agency


Strategy #1
Service Adaption: Develop service adaption techniques to tailor services based on tactical environment and physical limitations
Focus of this briefing
Enterprise Services
Core Networks
Tactical Services
Strategy #2
Design techniques and patterns to overcome the constraints in tactical env.
Strategy #3
Techniques to improve work performance and robustness to meet the service layer requirements
Tactical Networks
Strategy #4
ork & Service Mgmt
Identify management capabilities required to support the developed strategies

DISA

A Combat Support Agency

Summary of Service Adaption Strategies Mitigating Tactical Edge Constraints

Service Adaption Strategy	Definition
Tiered Service	Tiered service model is the technique to provide a simpler service with reduced functional capabilities to support constraints in the tactical edge environment. Tiered service model considers tactical edge constraints as part of requirements for service design.
Service Proxy	Service proxy is the technique to perform proxy based service adaption at the edge of tactical domain to interoperate with other service domains, thereby improving service delivery to tactical edge users. Service proxy uses techniques such as data compression, store-n-forward and adaptive content delivery to mitigate constraints in the tactical edge environment.
Service Broker	Service broker is the technique to use broker to reach multiple instances of a service residing on different servers to improve the service availability and quality. By reaching multiple instances of a service, service broker can mitigate the risk of disconnected server(s) at the tactical edge.

DISA
A Combat Support Agency

Mapping Service Adaption Strategies to Tactical Edge Constraints

Tactical Edge Constraints	Tiered Capabilities	Service Proxy	Service Broker
Disconnected		X	X
Low Bandwidth	X	X	
Limited Resources (SWaP: Size, Weight, Power)	X	X	

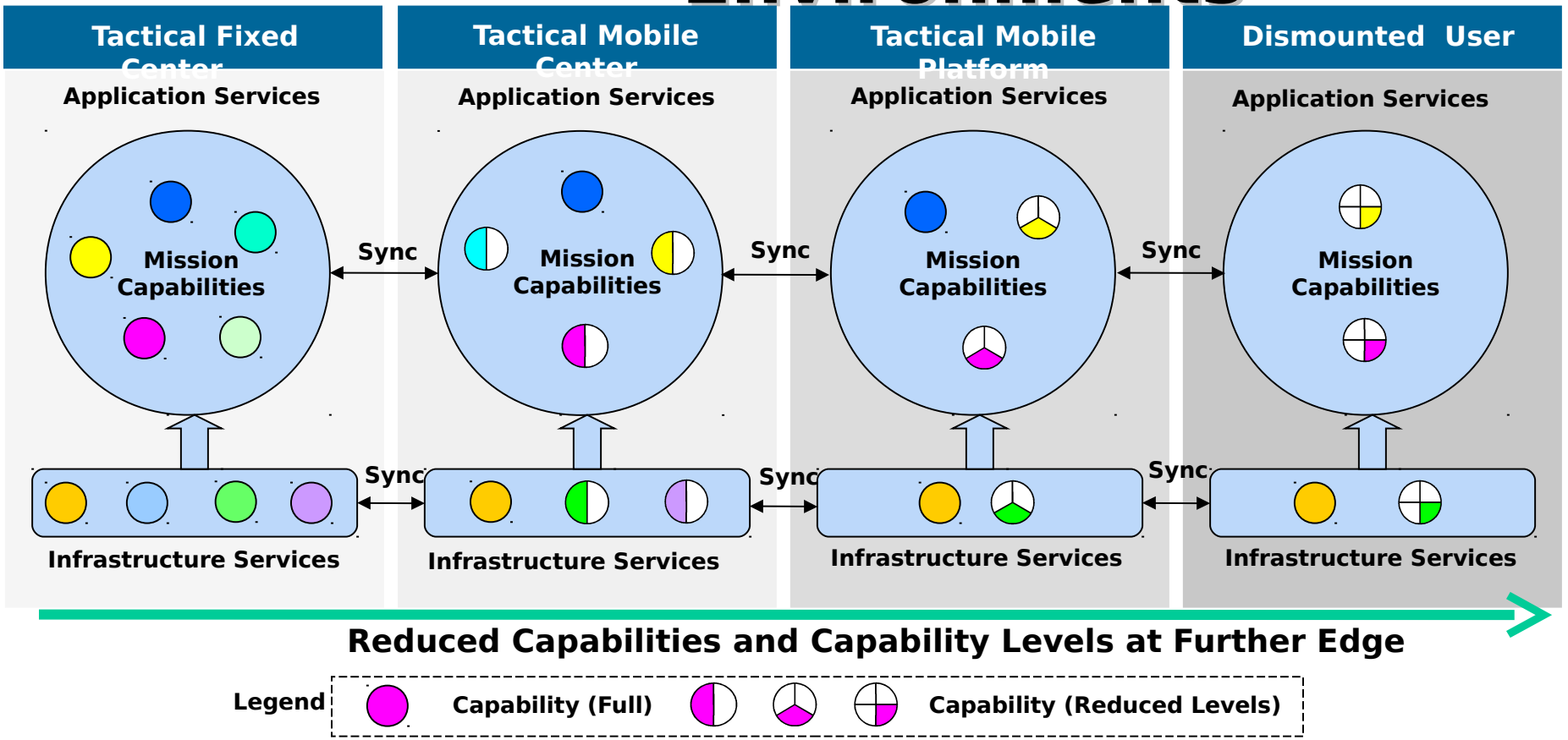
DISA
A Combat Support Agency

Tiered Service Model

- **Package mission capabilities into different services. Each service is composed of selected capabilities.**
  - **Service = { Capability 1, Capability 2, …, Capability N}**
- **Define one or more levels for a capability depending on the operational needs**
  - **Levels for Capability i = {Li1, …, Lim}**
- **Tailor service capability feature set and associated functional level to adapt to specific constraints in different tactical environments.**

Determine Tiered Capabilities for Different Tactical Environments

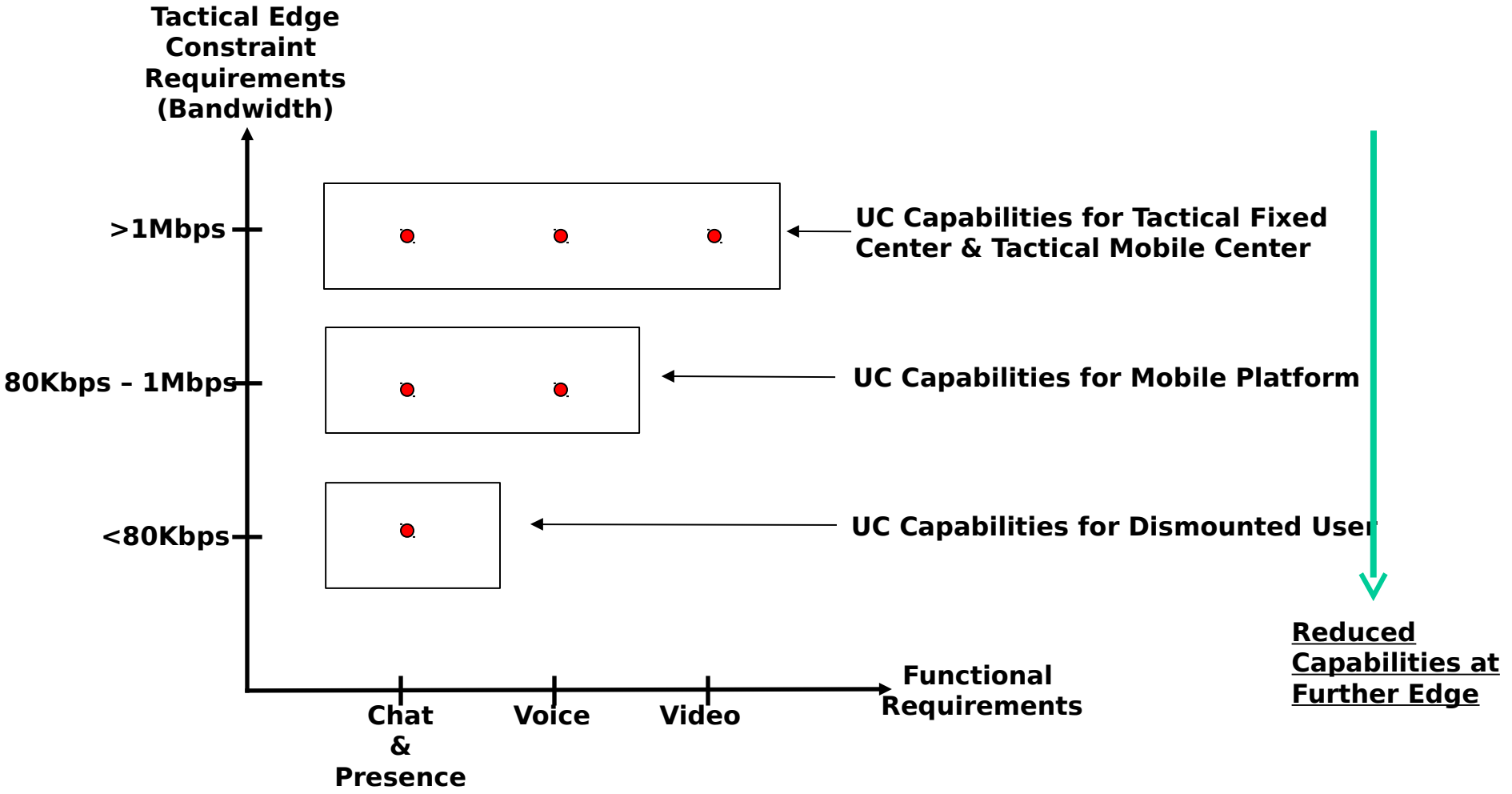
DISA
A Combat Support Agency



- **Determine service granularity for supporting mission capabilities based on both functional requirements and tactical edge constraint requirements. Capabilities meeting the same constraint requirements could be grouped together.**
- **Identify levels for a capability based on different levels of tactical edge constraints.**

Example Tiered UC Capabilities for Different Tactical Environments

DISA
A Combat Support Agency



DISA
A Combat Support Agency

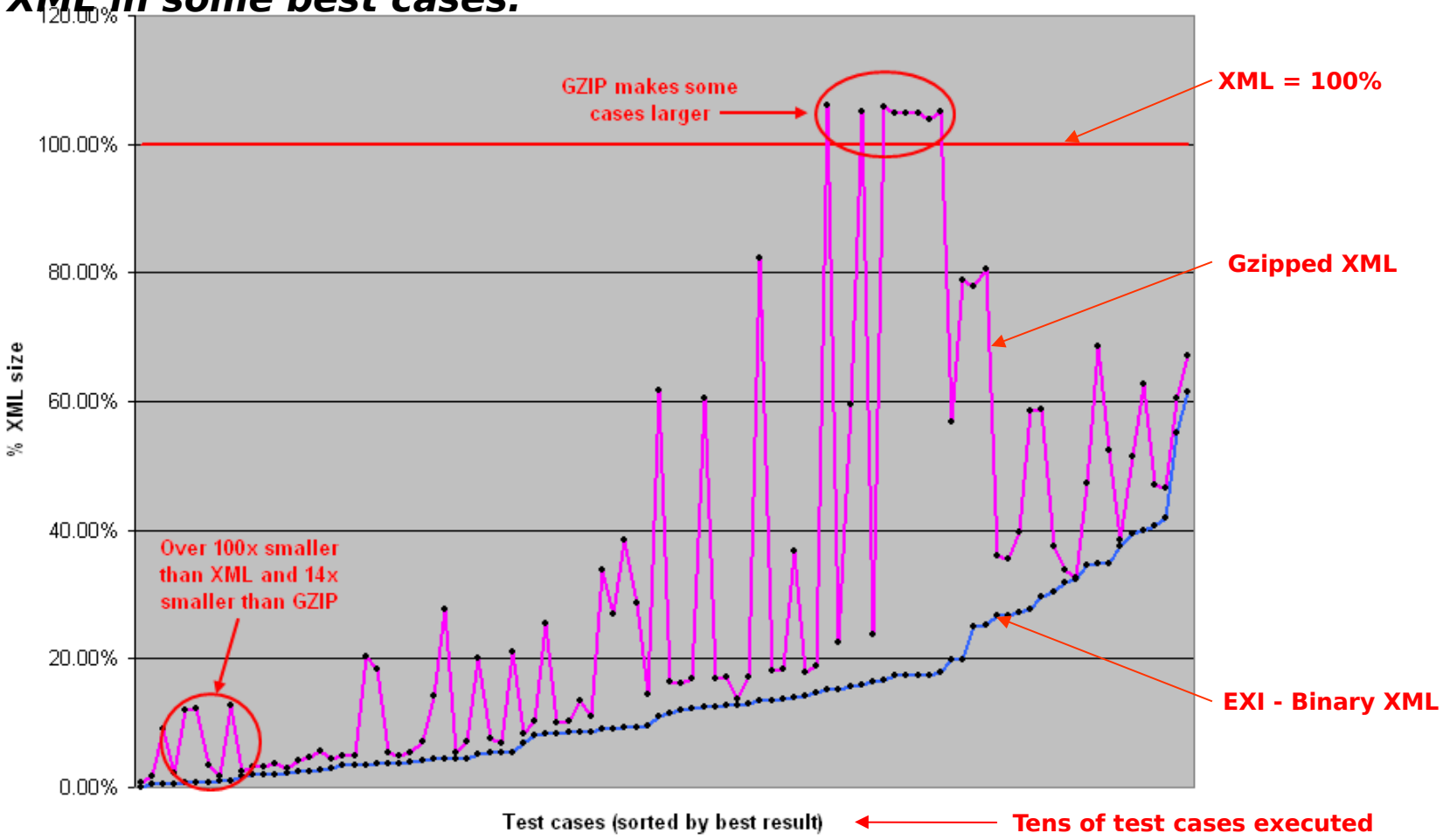
Proxy for Service Adaption

- **Perform techniques, such as data compression, data caching, store-n-forward, adaptive content delivery, QoS and data/protocol translation on Proxy to adapt services to tactical edge environment**
  - **Data compression using technologies such as binary XML can significantly improve the efficiency of using limited network bandwidth by condensing the amount of data delivered over the tactical edge network.**
  - **Store-n-forward can mitigate the data loss caused by disconnected network because the data would be stored on the proxy and redelivered once the network connectivity is restored.**
  - **Adaptive content delivery can perform functions, such as message filtering, to control content delivered to tactical devices with limited resources and bandwidth.**
  - **Data and protocol translation are often required to support interoperability between GIG core services and tactical services since tactical services may use design techniques unique to tactical edge environment to deal with tactical edge constraints (e.g., binary XML at tactical edge vs. standard XML in GIG core).**

Comparing Messaging Efficiency Among Binary XML, GZipped XML and XML

A Combat Support Agency

EXI is an example of binary XML technology and can effectively compress XML messages, e.g., up to 10 – 100 times smaller than XML in some best cases.



DISA
A Combat Support Agency

Service Broker

- **Use service broker to distribute a service request to multiple service instances on multiple tactical nodes.**
  - **If one tactical node hosting the service is disconnected, the client can still receive information from other nodes hosting the same service.**
- **Service broker may also aggregate and/or adapt results returned from multiple service instances.**
  - **Support different approaches of result aggregation, such as sorted by relevance and grouped by sources.**
  - **Adapt results to mitigate tactical edge constraints, e.g., message filters can be applied to control the amount of data delivered to a client.**

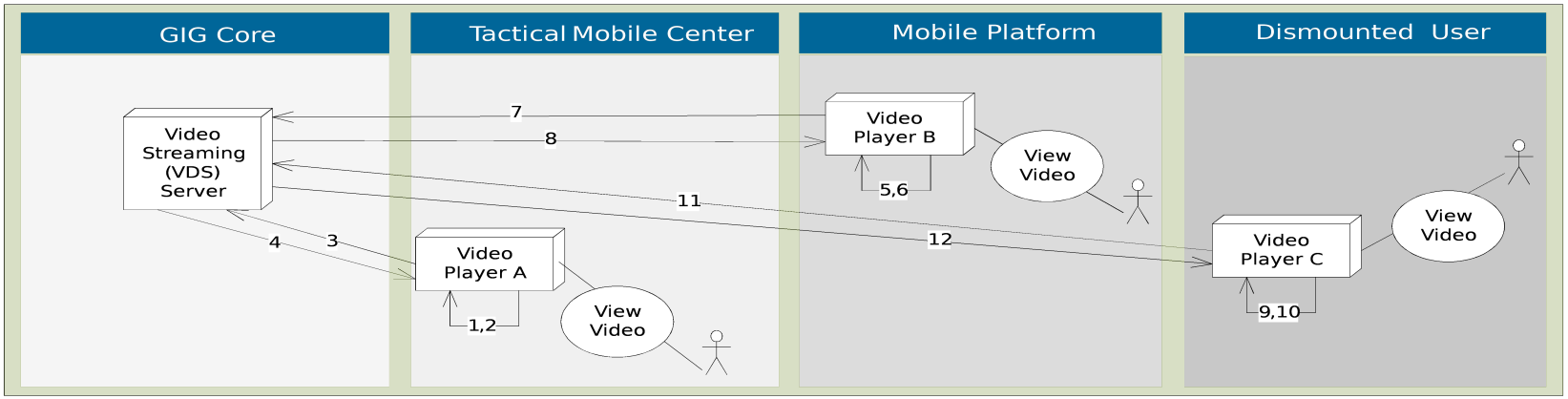
DISA
A Combat Support Agency

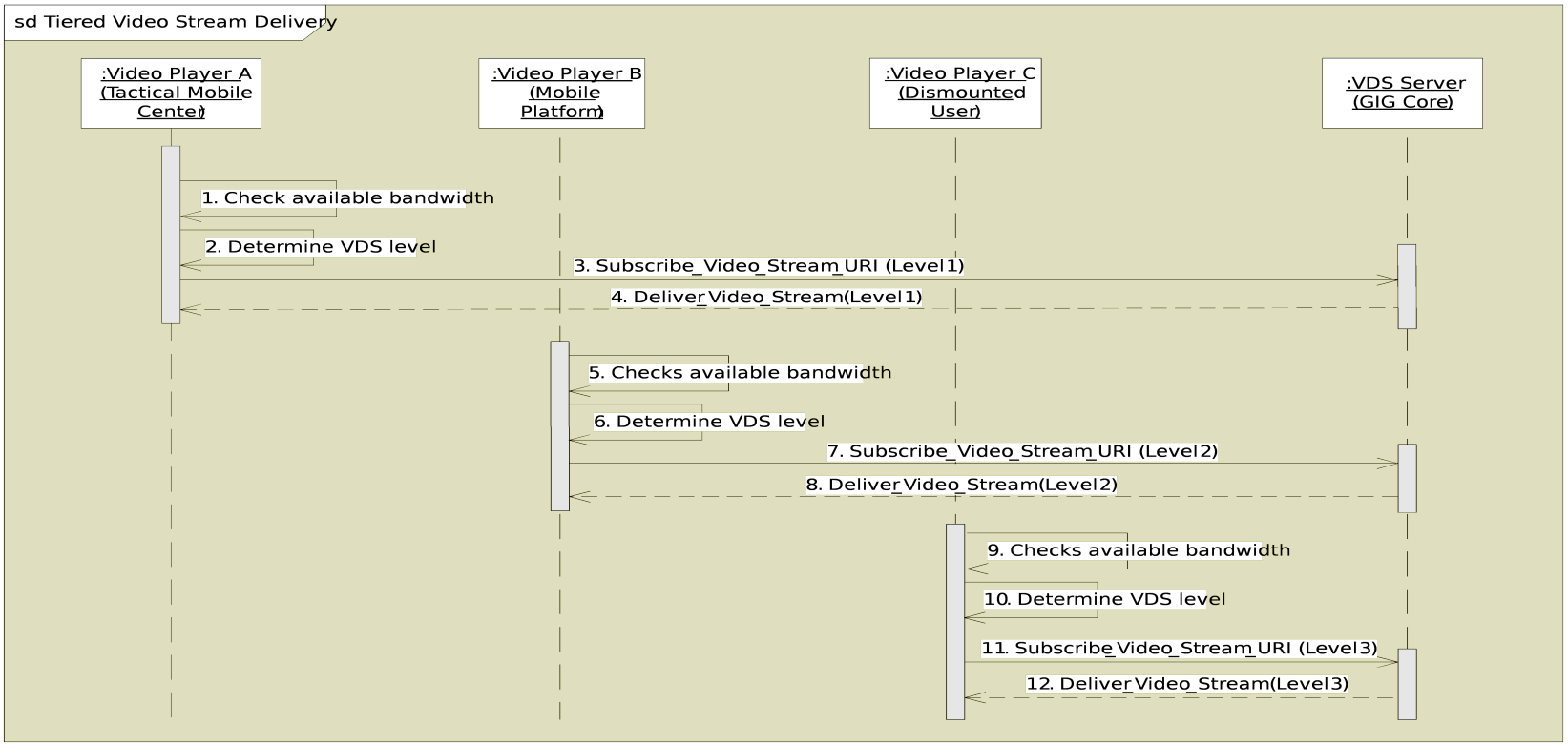
Problem 1: Video Streaming To Tactical Last Mile Problem

- **Problem Description**
  - **Video streaming service is not available to war-fighters in the tactical last mile.**
- **What Caused the Problem**
  - **Devices in the tactical last mile can only receive and play low bit rate live video and only limited bandwidth is available.**
- **Mitigation Techniques**
  - **Use Tiered Capability Levels.**
  - **Use Tiered Video Streaming Delivery design pattern.**

Design Pattern Example 1 - Tiered Video Streaming Delivery

A Combat Support Agency



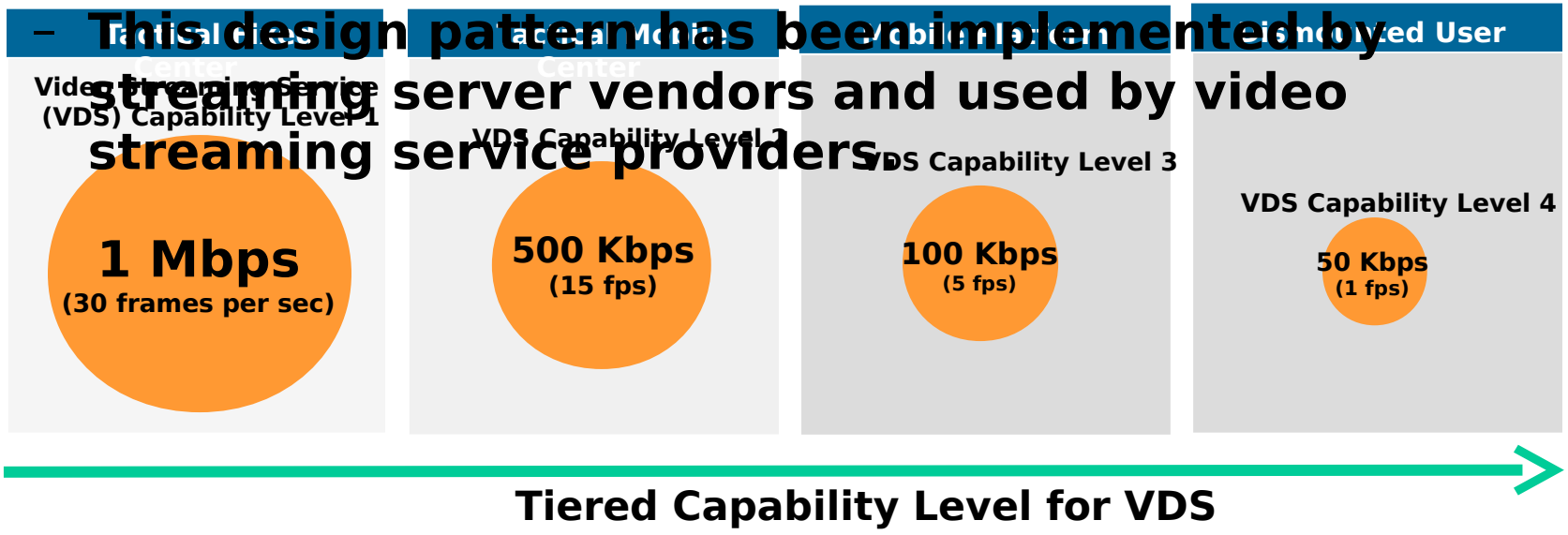


A Combat Support Agency

Design Pattern Example 1

(Cont'd) – Tiered Video Streaming Delivery

- **Highlights of the Design Pattern**
  - **Use video encoding technologies (such as Scalable Video Coding from ITU-T) supporting variable frame or bit rates.**
  - **Adapt video frame or bit rate delivered to an tactical edge enclave based on the enclave's available bandwidth.**
  - **This design pattern has been implemented by streaming server vendors and used by video streaming service providers.**



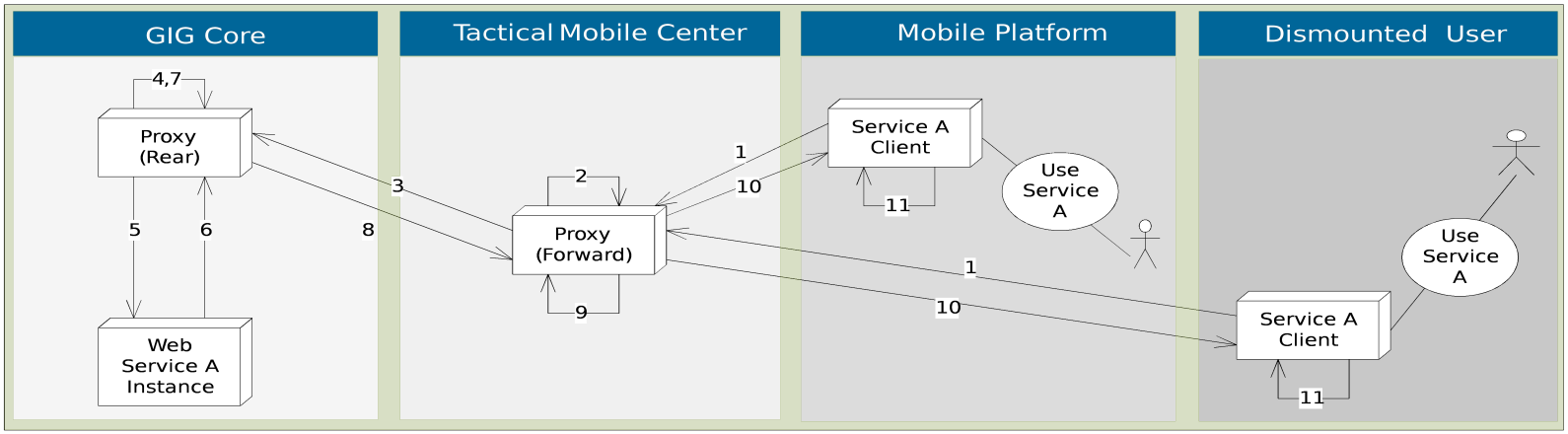
DISA
A Combat Support Agency

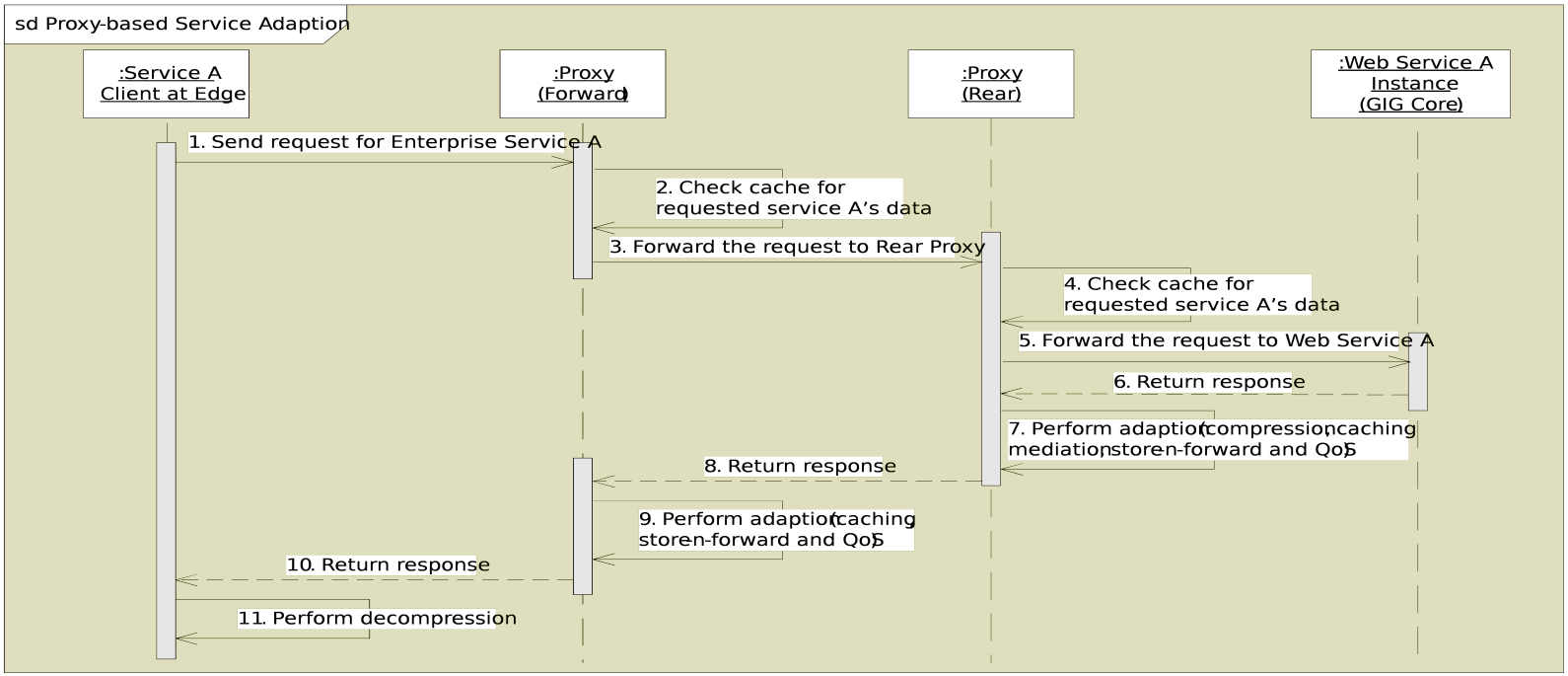
Problem 2: Performance Problem for War-fighters Accessing Enterprise Services

- **Problem Description**
  - **War-fighters in the tactical edge environment may experience poor service performance, such as long response time, when accessing enterprise services in the GIG core.**
- **What Caused the Problem**
  - **Enterprise services designed for the GIG core environment can not deal with DIL (Disconnected, Intermittent Connectivity and Limited Bandwidth) constraints in the tactical edge environment.**
- **Mitigation Techniques**
  - **Use Proxy for service adaption.**
  - **Use Proxy-based Service Adaption design pattern.**

Design Pattern Example 2 – Proxy-based Service Adaption

DISA
A Combat Support Agency




sd Proxy-based Service Adaption
:Service A Client at Edge
:Proxy (Forward)
:Proxy (Rear)
:Web Service A Instance (GIG Core)
1. Send request for Enterprise Service A
2. Check cache for requested service A's data
3. Forward the request to Rear Proxy
4. Check cache for requested service A's data
5. Forward the request to Web Service A
6. Return response
7. Perform adaption (compression, caching mediation, store-n-forward and QoS)
8. Return response
9. Perform adaption (caching store-n-forward and QoS)
10. Return response
11. Perform decompression

DISA
A Combat Support Agency

Design Pattern Example 2 (Cont'd) – Proxy-based Service Adaption

- **Highlights of the Design Pattern**
  - **Provide transparence to enterprise services in the GIG core environment since proxy can perform service adaption on behalf of enterprise services.**
  - **Improve service performance delivered to users in the tactical edge environment.**
    - **On behalf of enterprise services, proxy uses adaption techniques tailored to deal with tactical edge constraints, such as data compression and adaptive content delivery.**
  - **Rear proxy is used at the boundary between GIG core and tactical edge while Forward proxy can be used at the boundary between two tactical edge enclaves.**
  - **This design pattern has been used in DoD PoRs, such as Army SOSCOE.**

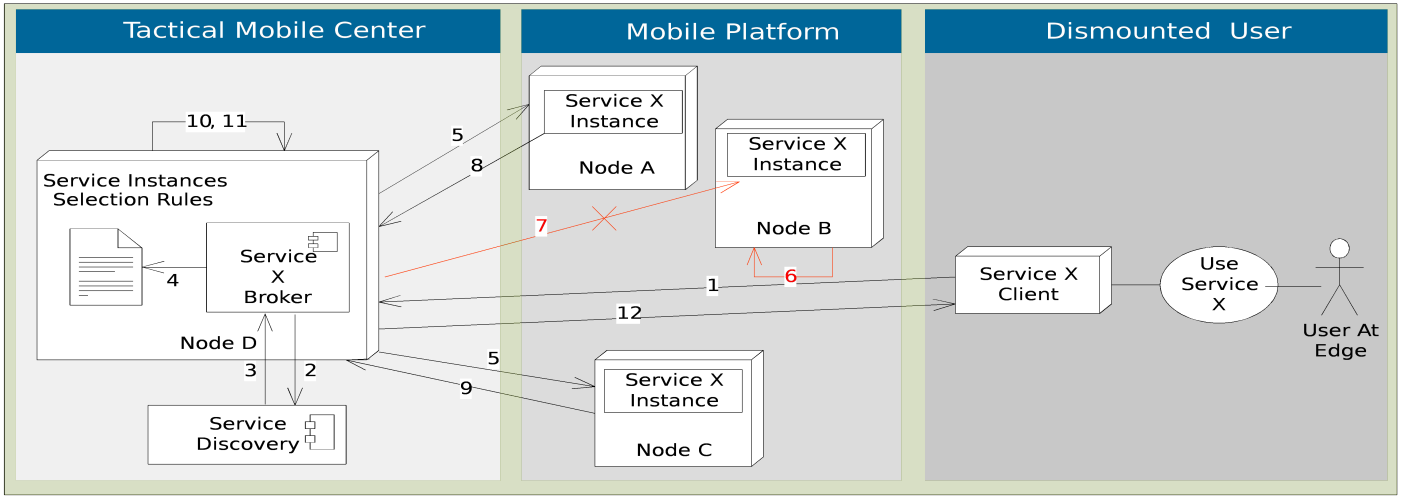
DISA
A Combat Support Agency

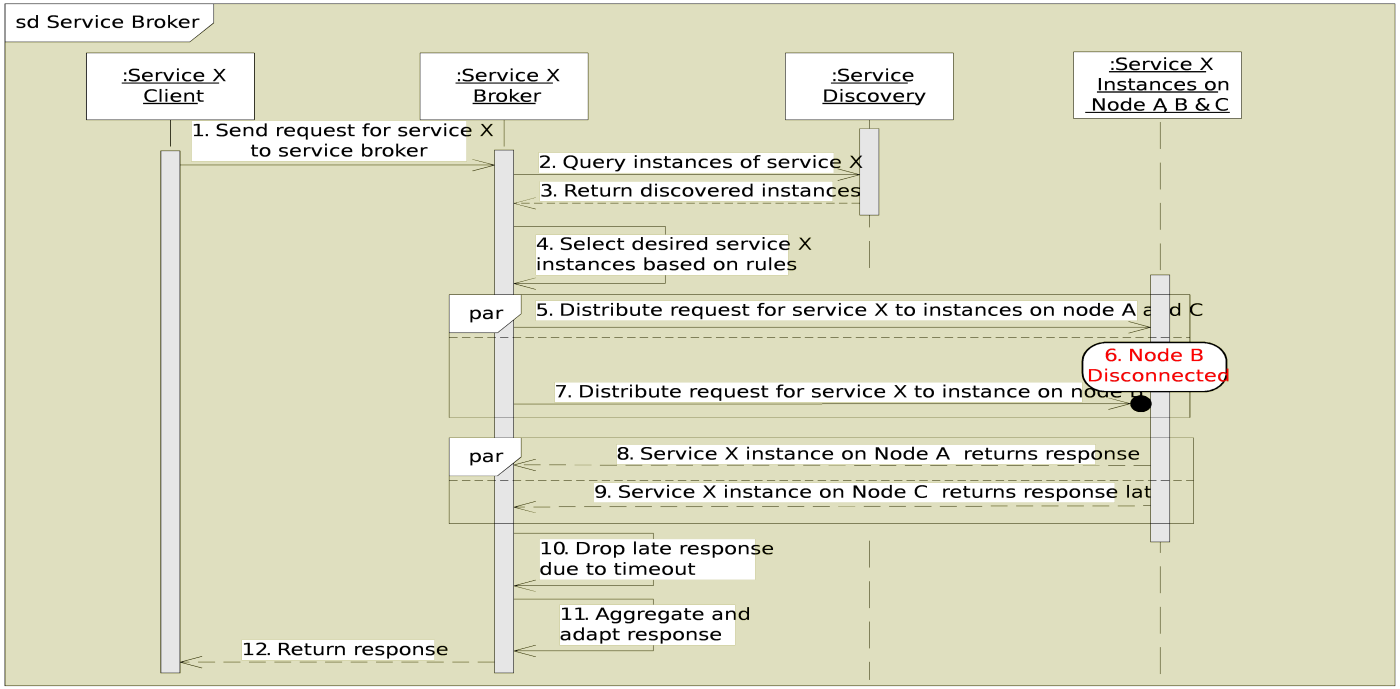
Problem 3: Unreliable Service Problem in Tactical First Mile

- **Problem Description**
  - War-fighters in the tactical first mile sometimes encounter the loss of services.
- **What Caused the Problem**
  - Tactical platforms hosting services can often be disconnected due to unstable wireless network connections caused by multipath, obstruction, hostile interference and other impairments in the tactical edge environment.
- **Mitigation Techniques**
  - Use Service Broker to improve the service availability.
  - Use Service Broker design pattern.

Design Pattern Example 3 – Service Broker

DISA
A Combat Support Agency





DISA
A Combat Support Agency

Design Pattern Example 3
(Cont'd) – Service Broker

- **Highlights of the Design Pattern**
  - **Improve service availability by distributing service requests to multiple instances of the same service.**
  - **Enhance information sharing and situation awareness by aggregating responses from multiple service instances.**
  - **Filtering, adaptive content delivery and other adaption techniques may also be applied by the service broker to improve service performance.**
  - **This design pattern has been used in DoD Content Discovery service.**

DISA
A Combat Support Agency

Way Ahead

- **Use adaption strategies, such as tiered services, proxy gateway and service broker, to improve the performance of service delivery to tactical users by mitigating a variety of tactical edge constraints.**
- **Next steps:**
  - **Summarize new findings from upcoming EWSE IPTs such as SO for DIL.**
  - **Introduce adaption strategies for tactical services to GIG software developer communities.**

DEFENSE INFORMATION SYSTEMS AGENCY